A

MEMOIR

TO THE

MAP AND DELINEATION

OF THE

STRATA

OF

ENGLAND AND WALES,

WITH PART OF

SCOTLAND.

BY

WILLIAM SMITH,
ENGINEER AND MINERAL SURVEYOR.

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TO

THE RIGHT HONOURABLE

SIR JOSEPH BANKS, BART.

PRESIDENT OF THE ROYAL SOCIETY,

AND

THE MOST GENERAL PROMOTER OF SCIENCE;

THIS WORK,

BY HIS PARTICULAR ENCOURAGEMENT ADVANCED TO ITS PRESENT STATE OF PERFECTION,

IS MOST GRATEFULLY AND RESPECTFULLY

Dedicated,

BY HIS OBLIGED HUMBLE SERVANT,

WILLIAM SMITH.

LONDON,
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INTRODUCTION.

After twenty-four years of intense application to such an abstruse subject as the discovery and delineation of the British Strata, the reader may easily conceive the great satisfaction I feel in bringing it to its present state of perfection. The chances were thought much against my ever completing it on a map, of the greater part of our island, large enough to show the general course and width of each stratum of the soil and minerals, with a section of their proportions, dip, and direction, in the colours most proper to make them striking and just representations of nature; and which is the first general mineralogical survey of the island.

The map also contains the relative altitude of the hills, which seem proportioned to the nature of the rocks of which they are formed; the highways, the streams, rivers, canals, and railways, upon a larger scale, and more correctly, than any map before published; also the situation of collieries and mines.

The wealth of a country primarily consists in the industry of its inhabitants, and in its vegetable and mineral productions; the application of the latter of which to the purposes of manufacture, within memory, has principally enabled our happy island

to attain her present pre-eminence among the nations of the earth. Whatever, therefore, tends to facilitate the discoveries and improvements of the one or the other, may with just propriety be considered a national concern, and cannot more properly be laid before the public than at a period when the wisdom and vigour of His Majesty's councils have given peace to a distracted world, and may render this happy event the commencement of a new era in the history of natural science.

The immense sums of money imprudently expended in searching for coal and other minerals, out of the regular course of the strata which constantly attend such productions; and in forming canals, where no bulky materials were afterwards found to be carried upon them; prove the necessity of better general information on this extensive subject. And I presume to think, that the accurate surveys and examinations of the strata, as well near the surface of the earth as in its interior, to the greatest depths to which art has hitherto penetrated, by the sinking of wells, mines, and other excavations, to which I have devoted the whole period of my life, have enabled me to prove that there is a great degree of regularity in the position and thickness of all these strata; and although considerable dislocations are found in collieries and mines, and some vacancies in the superficial courses of them, yet that the general order is preserved; and that each stratum is also possessed of properties peculiar to itself, has the same exterior characters and chemical qualities, and the same extraneous or organized fossils throughout its course. I have, with immense

labour and expense, collected specimens of each stratum, and of the peculiar extraneous fossils, organic remains, and vegetable impressions, and compared them with others from very distant parts of the island, with reference to the exact habitation of each, and have arranged them in the same order as they lay in the earth; which arrangement must readily convince every scientific or discerning person, that the earth is formed as well as governed, like the other works of its great Creator, according to regular and immutable laws, which are discoverable by human industry and observation, and which form a legitimate and most important object of science. The discoveries and improvements, both in mining and agriculture, which are now confined to a few parts of the kingdom, may be fully extended to many more, and in some degree to all, by a better knowledge of geology; and a faithful general view of the soil and substrata of our island (in which no beds are omitted that can well be described in such a map) will be found a work of great convenience, in considering the various applications which are made to the legislature for canals, roads, and railways alone. I am prepared also to give more minute and detailed delineations on a new impression of county or other maps, of the largest scale, and to illustrate, by lectures and by specimens, the particular sites of the numerous animal remains and vegetable impressions found in each stratum, with an accurate detail of every characteristic mark which has led to these discoveries, and to publish a complete illustration of my geological system.

By a knowledge of the alluvial deposits in low marshy grounds around the coast, which I have had frequent opportunities of investigating, and by more correct information concerning the shoals and sandbanks adjacent, great benefits may accrue both to the landed and commercial interests of the country in the draining of such low lands, and in the improvement of sandy and bar harbours. The higher lands of the interior contain a wonderful admixture of soils, stones, shells, marls, minerals, and fossils, very regularly deposited in strata, which rise successively to the surface of the earth. The purposes to which many of them may be applied, are doubtless still unknown. It has been the chief object of my research to simplify and extend this kind of knowledge, whence practical applications the most important may result; proofs of which might be given in the many works which I have executed on these principles, in different parts of the island; and by their more general diffusion, various works of art, and agricultural experiments in particular, will be generally conducted with more skill and certainty of effect. By a classification of soils, according to the substrata, good practical farmers may choose such as are best suited to their accustomed mode of management, and they may thus be tempted to transfer useful and well-established practices in husbandry to many parts of the same stratum, which are still highly susceptible of improvement; and beneficial results will be recorded with more regularity for the advantage of others, desirous of trying experiments upon the same strata.

On these principles also, the most proper soil will be known for plantations of timber: miners and colliers, in searching for

metals and coal; builders, for freestone, limestone, and brick-earth; the inhabitants of dry countries, for water; the farmer, for fossil manures; will all be directed to proper situations, in search of the various articles they require; and will be prevented from expensive trials, where there can be no prospect of success.

Finding good materials for roads, in the nearest places, will reduce that heavy public charge.

Tracing the courses of springs beneath the surface, will show the best methods of draining and improving land; and the collecting of water from those natural subterraneous reservoirs, the caverns of hills and joints of rocks, for the supply of canals.

Much of the art of constructing those public works, their value and utility, and the products of collieries and mines, depends upon this science, as also the perfection and extent of potteries, glass, salt, alum, vitriol, and saltpetre works; the procurement of fuller's earth, founders' and glass-makers' sand, of materials for chemists and colourmen, and the various substances used in grinding and polishing metals and marble: in fact, there are few arts or employments which may not derive some useful hint or improvement from a better knowledge of the products of our soil and substrata.

It will appear as unnecessary, as it would be difficult, to enumerate all the advantages, when it is considered what numerous

coincidences and indisputable facts have occurred (in the course of so many years constant observation and experiment on strata, in different parts of the country) to found this extensive investigation, which must lead to accurate ideas of all the surface of the earth, if not to a complete knowledge of its internal structure, and the progress and periods of formation; for nothing can be more strongly and distinctly marked than the line which separates the animal from the vegetable fossils, and the courses of numerous strata, which are designated by these and other characters, the most intelligible and useful.

MEMOIR,

&c.

EXPLANATION OF THE SUBJECT OF STRATA, AND OF THE COLOURS BY WHICH THEY ARE REPRESENTED ON THE MAP.

The courses of the strata, or the length and breadth of surface occupied by each as they rise successively from the level of the sea on the eastern to the western side of the island, are represented by colours.

The edges of the strata, which may all be crossed in a journey from east to west, are called their outcrops; and the under edge of every stratum, being the top of the next, and that being generally the best defined, is represented by the fullest part of each colour.

It is thus readily shown that the most general course of the strata is from south-west to north-east, and, in some parts, nearly north and south; while, in the southern parts of the kingdom, many of their terminations have a contrary direction.

The colours, though brighter than those they represent, are in some degree assimilated to the colour of each stratum, except the chalk, which, being colourless, seemed best represented by green, strong colours being necessary, and no stratum of equal extent requiring that colour.

In some cases, where the strata are much alike, as the oolytes, Nos. 7 and 12, they are represented by light and dark yellow.

The strong blue represents the lias limestone, Nos. 15 and 16; and the light blue, the blue marl, No. 14, which lies over it.

The black shades represent the coal-measures, or the strata which generally contain coal, more or less valuable, several beds of which are too thin for working. The most productive parts are described by the darker shades, which abound with numerous crosses, the sites of the collieries.

In this mode of representing the strata by colours, various insular or detached parts of the same colour may be observed. Where these occur upon high ground (which will be known by attending to the ramifications of the rivers), they represent insular parts of the same stratum; but where they occur in low ground (which seldom happens but by the side of large rivers) they represent the denudated parts of a stratum, whose regular outcrop may be at a considerable distance.

Instances of the latter occur in the (green) representations of the chalk in Norfolk and Suffolk; and of the former in the (yellow) representations of stone-topped hills in the vale of Gloucester. Smaller isolated parts of some of the colours may be observed, chiefly blue, interspersed in the red and in the purple: the first intended to represent points in the courses of limestone, which alternate with red and dunstone, and the other with the killas, or slate; in some parts of which, points enough are ascertained to give the direction of such courses of limestone; but these and other vacancies may be speedily and correctly made up by several able geologists, who are now indefatigably engaged in the pursuit.

In many cases the edge of one stratum terminating on another is so gradual, as not to admit of any distinct or definite line. On this account, those strata only which are the most strikingly contrasted, are

Ora

Strata.	Th
1. Chalk	
2. Sand	
3. Clay	
4. Sand and Stone	
5. Clay	
6. Forest Marble	
7. Freestone ...	
8. Blue Clay ...	
9. Yellow Clay .	
10. Fuller's Earth	
11. Bastard ditto, and Sundries	
12. Freestone ...	
13. Sand	
14. Marl Blue ..	
15. Lias Blue ...	
16. Ditto White .	
17. Marl Stone, Indigo and Black Marl	
18. Red-ground .	
19. Milstone.	
20. Pennant Stone	..
21. Grays	.
22. Cliff.....	
23. Coal.....	

drawn on the map, and the spaces not coloured are supposed to be occupied by those which are intermediate. Thus, the loose stratum of sand which lies over the chalk in the flat lands of Norfolk and Suffolk, is too vaguely defined for accurate delineation; but the clay over it, which is drawn, can be more clearly distinguished. The loam, which is a gradation of sand, will, therefore, be generally found nearer to the clay than to the chalk.

The annexed Table No. I. is a copy of the first MS. attempt at any regular account of my discoveries in the strata, a copy of which being shown to me by the late W. Reynolds of Colebrook-dale, about twelve years since, and being assured by him and others of its multiplication and general distribution, even to the East and West Indies, I am induced to publish it in the original form.

The thickness of several of the strata was under-rated, and some few mistakes were made in other parts of the paper, which, in the progress of the work, will be corrected; but this short account of my early discoveries of regularity in the succession and courses of the strata within twenty miles of Bath, with the peculiar extraneous fossils by which they are characterized, became a key to the further courses of these and all other varieties in this island, which was easily transferred to the same kind of strata on the continent.

Soon after the compilation of this paper, the courses of other strata above the chalk, and beneath the coal, were clearly ascertained. Those over chalk are chiefly sand, clay, and brick-earth, with various interspersions of gravel and crag; those beneath the coal, sandstone, limestone, slate, and granite.

The colours used upon the map to denote the various strata are explained in the Table No. II.

The Canals are marked by a strong treble line, thus
Tunnels . . . . . .
Rail-roads, by a close and strong double line . .
Other Roads, lighter and more open . . . . . .
Collieries . . . . . + + +
Lead Mines . . . . . .
Copper Mines . . . . . .
Tin Mines . . . . . .
Salt and Alum Works . . . . . o o o

Salt-works are in the red land of Cheshire, Shirleywich near Stafford, and at Droitwich near Worcester. Alum-works about Whitby and other parts of North York moors.

The figures denote, in feet, the correct altitude of many of the principal hills and mountains above the level of the sea.

The canals are added to this map, for the purpose of showing how the heavy articles of subterraneous produce may be best conveyed from their native sites in the strata to the places of consumption.

It may thus be seen what parts of the kingdom have benefited the most by canals, and where they are still wanting, and from whence the heavy articles of tonnage (which alone can render them profitable) may be the most readily obtained. The principal railways which are used for the same purpose, are also shown.

It is to the establishment of these great works and the minerals which they have distributed, that England owes half her present consequence in the scale of nations; for these works are the result of those energies of the mind which have called forth the labours of the industrious, and furnished humanity with every thing that is great and good; and it is hoped that many more such works may yet be established, with the aid of a better knowledge of the rich contents of our substrata.

Explanation of COLOURS o

Nos. which refer to the preceding List of Strata.	
	London Clay, other detache
	Clay or Brick-e
	Sand, or light I
1	Chalk { Upper / Under
2	Green Sand, pa
3	Blue Marl, so in some place
	Purbeck Stone Pickering.
	Iron Sand and contains Full and Glass Sa
	Dark Blue Sh ture, in Nor
	Cornbrash, a t
5, 6	Forest Marble Slate.
7	Great Oolyte,
12, 13	Under Oolyte,
14	Blue Marl, un
15, 16	Blue Lias Lim
	White Lias, no
18, 19	Red Marl and Springs.
	{ Magnesian I / ——— s
20 to 23	Coal districts, Coal .....
	——— G
	Derbyshire Li
	Red and Dun- interspersion
	Va
	Killas, or Slat western sid stone, mark
	Granite, Sieni
	Alluvial depo are shaded a

The Society of Arts very wisely foresaw, in offering their premium for a mineralogical map (which I have just had the honour to obtain), that one of the greatest difficulties in understanding such an extensive branch of natural history arose from the want of some method of generalizing the information, which could only be supplied by a map that gives, in one view, the locality of thousands of specimens. By strong lines of colour, the principal ranges of strata are rendered conspicuous, and naturally formed into classes, which may be seen and understood at a distance from the map, without distressing the eye to search for small characters. This is the advantage of colours over any other mode of representation.

The diagram annexed to the map will best explain how the different chains of hills are formed by the principal masses of strata. It being, however, desirable to many to know the general course which they take, and nearly what portions of each county they occupy, I shall first so describe them.

GENERAL ACCOUNT OF SOIL AND SUBSTRATA IN THE RESPECTIVE COUNTIES.

No. 1, Middlesex. 2, Essex. 3, Suffolk. 4, Norfolk. 5, Surry. 6, Kent. 7, Sussex.

8, Hants. 9, Dorset. 10, Wilts. 11, Berks. 12, Oxford. 13, Bucks. 14, Beds. 15, Herts. 16, Cambridge.

17, Somerset. 18, Gloucester. 19, Worcester. 20, Warwick. 21, Leicester. 22, Northampton. 23, Huntingdon. 24, Rutland. 25, Lincoln.

26, Devon. 27, Monmouth. 28, Hereford. 29, Salop. 30, Stafford. 31, Cheshire. 32, Lancashire. 33, Derby. 34, Nottingham. 35, York. 36, Durham. 37, Northumberland.

38, Cornwall. 39, Wales. 40, Westmorland. 41, Cumberland. 42, Scotland.

Alphabetical List of Counties.

	No.	County Town.
Bedfordshire	14.	Bedford.
Berkshire	11.	Reading.
Buckinghamshire	13.	Buckingham.
Cambridgeshire	16.	Cambridge.
Cheshire	31.	Chester.
Cornwall	38.	Launceston.
Cumberland	41.	Carlisle.
Derbyshire	33.	Derby.
Dorsetshire	9.	Dorchester.
Devonshire	26.	Exeter.
Durham	36.	Durham.
Essex	2.	Chelmsford.
Gloucestershire	18.	Gloucester.
Hampshire	8.	Winchester.
Herefordshire	28.	Hereford.
Hertfordshire	15.	Hertford.
Huntingdonshire	23.	Huntingdon.
Kent	6.	Maidstone.
Lancashire	32.	Lancaster.
Leicestershire	21.	Leicester.
Lincolnshire	25.	Lincoln.
Middlesex	1.	Brentford.
Monmouthshire	27.	Monmouth.
Norfolk	4.	Norwich.
Northamptonshire	22.	Northampton.
Northumberland	37.	Newcastle.

	No.	County Town.
Nottingham	34.	Nottingham.
Oxfordshire	12.	Oxford.
Rutland	24.	Oakham.
Shropshire (Salop)	29.	Shrewsbury.
Scotland	42.	Edinburgh.
Somersetshire	17.	Ilchester.
Staffordshire	30.	Stafford.
Suffolk	3.	Bury St. Edmunds
Sussex	7.	Lewes.
Surry	5.	Guildford.
Wales	39.	
Warwickshire	20.	Warwick.
Westmorland	40.	Appleby.
Wiltshire	10.	Salisbury.
Worcestershire	19.	Worcester.
Yorkshire	35.	York.

As the boundaries of counties, or any other political divisions of the kingdom, might interfere with the outlines of strata, by which the island is naturally divided into districts, they are omitted, and the names of those primary divisions of the country only inserted.

The following short descriptions of strata, in each county, will generally be given in the order of their appearance on the surface, from east to west.

1. MIDDLESEX.

A large part of this county is covered by the metropolis, and its thickly inhabited and highly cultivated vicinity. By the numerous excavations thus occasioned, but little variety of strata is ascertained, even to the greatest depth of wells.

Blue clay is the most prevalent, and thence called the London clay. Its outcrop makes the strong soil of most of the pastures on the north side of London. It is very commonly an excellent brick-earth, to the depth of many feet beneath the surface; but a large portion of the regular strata in Middlesex is covered with alluvial gravel, which makes a lighter soil. There is some gravel mixed with clay. The small round pebbles blended with sand, which are common to the strata over chalk, form the surface of the poor commons toward the north-west; and in that extreme angle of the county some chalk is dug.

Great part of the flat thence to the Thames is covered with alluvial gravel, which extends down to the low marshy ground by the side of that river.

2. ESSEX.

The moderately elevated and most interesting part of Essex is formed of a part of the London clay, which takes a north-easterly course through this county.

These clays and strong loams form an agreeable undulating surface between Romford and Chelmsford, and to the eastward of that road, the slopes of which are finely wooded with the oak, which thrives admirably well on this soil. The forest, and parts westward of Chelmsford, seem to be composed of much the same strata.

From Chelmsford north-eastward to Colchester and the sokens, is a large breadth of mixed soil and substrata, light loams, or sandy, with an absorbent substratum, and some interspersions of wood, which are chiefly clay. Colchester seems the capital of this district.

The eastern shore is very flat and marshy; but lately much improved by draining.

The western portion of the county contains chalk, and greatly resembles the adjacent part of Hertfordshire. Some chalk, and its usual incumbent gravelly soil, forms the boundary of the Thames marshes.

3. SUFFOLK.

Norfolk and Suffolk are so commonly coupled together, and talked of as one, that they might be so considered in this general description of the most prevalent soils and substrata, had I not proposed to give each county in England separately.

The soil, as well as the management of it, in these two counties, are much alike, except that Suffolk has a greater breadth of the clay or woodland soils; and no where such connected breadths of good loams as in Fleg and Blofield, although there is much of this kind of land in the county, on the borders of the clay.

The most striking features of the county are, two very sandy districts to the east and west of a large intermediate surface of clay, the greater part of which is called Woodlands, or High Suffolk. Chalk lies under the western sands, and extends thence to Newmarket Heath, and to the border of the fens. A considerable portion of this low alluvial district is in Suffolk.

Crag abounds in the eastern sands.

4. NORFOLK.

The surface of Norfolk, and the greatest varieties or particular districts of its soil, seem naturally divided into five parts: the rich loams of Fleg, Blofield, and the vale of Aylesham, with considerable and intricate interspersions of low and wet marshland—a sandy district around Norwich, and thence north-westward to the sea, with interspersions of chalk—clay and strong loams on the higher lands, through the middle of the county, from south-east to north-west—light lands, with a dry surface and a thick stratum of chalk beneath—and, in the western extremity, a large portion of alluvial matter in the fens. The carstone, or iron sand, makes a conspicuous figure in a range of poor heaths between the chalk hills and marshland.

Of all these, the Flock district is the largest; which, being on a dry substratum of chalk, with a sandy surface, and this joining in the north to the other sandy district, which reaches to the vicinity of Norwich, give Norfolk the general character of sandy soil, although there is much strong land in the interior.

5. SURRY.

Surry is distinguished by a chalk ridge through the middle of the county; and, on the south side of this, a parallel ridge of dark brown sand. The woody part, still further south, is composed of the same kind of clay and soft sandstone as the wealds of Kent and Sussex. The latter strata, from Leith Hill westward, form high and poor heathy surfaces.

The west and north-western portion of the county, on the other side of the chalk-hills, is distinguished by great breadths of similar sandy and poor heathy surfaces, on the strata which lie over the chalk. These sands are generally intermixed with gravel or small black cherty pebbles. The extent of this surface, and of the chalk, is marked by the downs and light and dry soil, which it generally produces.

Clay-hills, similar to those on the north side of London, and of the same strata, fill up the remainder of the space to the side of the low and originally marshy ground in the vicinity of the metropolis.

6. KENT.

Kent and Sussex, like Norfolk and Suffolk, are so often coupled together, that they need scarcely be considered apart. Their stratified parts are the same; but the marshes in Kent give it a character which does not belong to Sussex. These, like the similar flats of the other side the great estuary of the Thames, are parallel to its shore, also in the flat which separates the Isle of Thanet from the main land of Kent, and in the great district of Romney Marsh.

Interspersed with the first-described district of these marshes, and parallel to them and the chalk, are knolls of the London clay, pebbly and sandy subsoil, in some places producing very good loamy land,

and in others very indifferent. The chalk, rising from beneath this south and south-westward, terminates abruptly in an angular course through the county, from the cliffs of Dover to its western extremity, and, at Barham Downs and in other parts, forms that kind of dry surface of short grass, or down-land, by which the outcrop of this stratum is commonly distinguished.

The dry surface of the Isle of Thanet has chalk beneath.

The oak-tree soil may be traced through small woods, parallel to the chalk, with the carstone sand and limestone rising into a well-defined ridge, with a flatter district of clayey commons, &c. between that and the soft sandstone of the higher part of the wealds or forest ridge.

7. SUSSEX.

The chalk hills of the South Downs produce the boldest feature of Sussex, and occupy a fourth of the county, in a ridge which extends east and west, the longest way of it, from Beachy Head to the western extremity.

East of these hills, in the low district called Manhood, is a portion of the sands, clays, and brick-earth, whose surface, as in many other parts over chalk, produces a fine loamy soil for tillage. This extends along the flat coast to Brighton.

On the north side of the chalk, and parallel to it, some of the same kind of sand as in Surry appears occasionally, and also the clay, or oak-tree soil, which accompanies it.

The clay, with some modifications (and in some parts of it beds of Sussex marble, or sneg stone), occupies lower moderately rising ground, in a course parallel to the chalk hills, and seems to terminate in the rich alluvial marshes of Pevensey Level.

The northern part of the county gradually rises to the higher lands in the forest ridge; much of which, on a poor surface of soft sandstone, is yet appropriated to the growth of timber, or remains, like the similar soil of North York moors, in an uncultivated state, and is, like that dreary district, still covered with rusty-looking ling.

8. HAMPSHIRE.

Hampshire, like Norfolk, has but two sorts of strata, and no stone fit for building, except from the back of the Isle of Wight; and this small part of the county makes the only difference between these two distant counties, except that the surface of Hampshire is not so sandy. The bulk of the chalk runs through the middle of Hampshire; but in Norfolk it is chiefly on the western side, and the poor commons of the stratum over it lie to the east and midland parts. In Hampshire, the same sort of commons lie in the northern and southern part of the county.

The New Forest, and the Forest of Bere, constitute a large portion of the southern parts; the clay, sand, and gravel of which appear to occupy nearly as large a space as the chalk of the dry downs and arable land in the northern part. A little of the carstone sand, and the poverty of the Surry and Sussex sandstone of the forest ridge, come into the eastern part of Hampshire.

9. DORSETSHIRE.

Dorsetshire partakes of three of the great strata which form some of the first features in the island, viz. the forest, heath, and extensive common surface—the chalky (arable and down land), and the stony district. Though these are the most conspicuous divisions of the county, yet each of them will produce considerable varieties. The first may be divided into, 1. light loamy land, inclinable to sand; 2. poor thin gravel; and, 3. stiff clay. The first of these is chiefly good arable land; the second generally heath and common; and the third produces

fine timber, which is chiefly oak; and, where it is not too wet, is good arable, which ploughs rather stiff, like much of the clay in Essex and Suffolk.

The heaths and commons are by far the greater portion of this sand, and give to all the eastern part of the county a general appearance of dreariness, like Bagshot Heath. These form the second principal class of Dorsetshire strata. The chalk is the first, with its usual surface of high down land and dry arable. The green and iron sand, which in many parts appears only in a narrow ridge, parallel to the chalk, here expands over a vast surface of high poor land in Dorsetshire, bordering upon Blackdown, and partaking of its general appearance and properties. In the vale of Blackmore, a great breadth of the oak-tree clay, and the clunch clay, spread from the base of the chalk hills to the edge of the cornbrash limestone; which, with some interspersions of clay and stone, and a part of the oolyte rocks about Sherborne, occupy the remainder of the county. Somewhat of the same kind of limestone appears about Bridport. And the Purbeck stone is the same as that in the vale of Pickering.

10. WILTSHIRE.

Wiltshire has four leading features: the chalky (arable and down land), and the stony land bordering upon Gloucestershire (which Mr. Davis has called the Cotswold part of the county), are the most striking, on account of the boldness of the hills produced by such thick strata: but the other two principal divisions are very distinct, and clearly to be traced in the sand, which follows the chalk, and the clay, which lies between the sand range and the stony part. This clay is the stratum which more particularly characterizes the strong lands of the vale of North Wilts. The stubborn soil, which is the effect of a too near approach of this stratum to the surface, is, however, in great breadths of this district, much improved by the fine soil of a considerable covering of gravel.

A fifth sort may also be distinctly traced through the clay-lands between the sand ridges and the chalk, which is called the oak-tree soil.

11. BERKSHIRE.

Berkshire partakes much of the same strata as Buckinghamshire, and other counties over the Thames in a north-eastern direction; but its chalk hills are not so deeply spread with the strong soils of the superincumbent strata; the principal parts of those heights are therefore less covered with timber. The eastern and southern part of the county consists entirely of the clays, sand, and gravel, incumbent on chalk, and has large portions of its surface in forests, commons, or extensive woods.

The clay-land of the vale of White Horse, and the sand ridge which succeeds it to the north, with a narrow strip of another clay, parallel to the Thames, occupy the remainder of the western part of the county.

North of the forest and heathy district, in the eastern part, and bounded by the Thames, is a fine dry surface soil, on a thick substratum of chalk, with some interspersions of the clay over it, which are covered with wood.

12. OXFORDSHIRE.

Oxfordshire, though a small county, of very irregular figure, partakes of a considerable variety of strata. It has some part of all, from the brick-earth and sand above the chalk, down to the blue marl. The portions of the former, on the clayey common of Nettlebed and woody heights adjacent, are but small. The chalk makes a bold figure in Stokenchurch hills and in the ground which slopes towards the Thames. The oak-tree clay may be traced, in its proper character, from Newnham north-eastward; and the sand and its accompaniments in its course across the narrowest part of the county, is equally distinct. The blue shale through Ottmoor, and the wet and dirty part in the south-west,

parallel to the Isis, has a character too plain to be mistaken, and is only rendered habitable by the fine clean gravel, which is usually lodged on it in sufficient thickness to produce materials for the roads and an excellent soil. Dry stony soils and substrata, like the Cotswold hills, rise to high land, and occupy the remainder; which, in the north-western and northern extremity of the county, is, like the adjacent part of Northamptonshire, interspersed with valleys of strong blue marl and clay. The latter part is by far the largest of all these natural divisions in the county.

13. BUCKINGHAMSHIRE.

Buckinghamshire has all the varieties of Oxfordshire, but differs from it in having but a small portion of that kind of stony land which characterizes the north-western part of the latter county. It has considerable breadths of poor sandy and gravelly heaths above the chalk; a bold ridge of chalk; its clay-land vale of Aylesbury, succeeded by a sand and sandstone ridge; a district of strong clay-land, with its usual wet surface, and a drier limestone, which skirts the northern part of the county, in a north-eastern direction, parallel to the river Ouse.

14. BEDFORDSHIRE.

Bedfordshire has an interior ridge of sand, and partakes largely of an interior ridge of chalk, between which is a course of stiff clay-land, which, toward the sand, extends to the heights. These are the three principal features of the south-eastern half of the county.

Parallel to the sand, which extends through the county from north-east to south-west, in the vale of Bedford, lies the thick stratum of dark blue shale, which is common to other valleys and low land to the north-east and south-west. In the northern part of this county, as in Huntingdonshire, it extends to the heights. Where the soil is formed on its surface, nothing can be more difficult to cultivate; but the gravel in the vale of Bedford, as about Huntingdon, has happily covered it to

a good thickness, and produced a better soil. This clayey stratum is found under all the northern half of the county, except in a few places, where the cornbrash limestone appears.

15. HERTFORDSHIRE.

The north and north-western extremities consist of the openness and aridity of surface which the most elevated parts of the thick chalk stratum generally produce; and the southern part of the county, of the woody eminences of the clay over the chalk. Most of the valleys of Hertfordshire are deep enough to expose some of the chalk, which is the general base of the county; and the intermediate heights partake of the sand, gravel, and clay, which are its usual covering.

16. CAMBRIDGESHIRE.

Cambridgeshire has but little variety of strata. This county includes a large portion of the adjacent fens, and the alluvial matter about Cambridge hides much of the dry sandy soil which usually appears at the foot of the chalk. The open arid surface over the chalk, which stretches along the south-eastern side, and the clay soils on the western side, are the principal distinctions in the substrata. One half of the county is fen. The gravel in the vicinity of Cambridge makes a good soil, and the most agreeable walks.

17. SOMERSETSHIRE.

This county is generally considered in two parts, the northern and southern; it being divided nearly in the middle by the great ridge of hills called Mendip; and, in going westward, the county assumes a quite different character, from the south side of that hill. Somerset is compounded of such a great variety of strata, as makes it difficult of general description. Freestone forms a conspicuous feature in all the hills of the north-eastern part; and the same strata, sweeping in a long curve round its southern boundary, seem to enclose, by the help

of Mendip and the Quantock hills, a large interior district of low land, great part of which is alluvial soil or rich marsh land; another, rich pasture, on blue marl; and the remainder, interspersions of lias and red marl. This latter extends through the fine vale of Taunton; and behind this, a considerable district of poorer surface, on killas and its accompaniments, rises to the heights of Exmoor, terminating on the shore in bluff headlands of red and dun-stone. These latter strata generally produce a hilly but not unfertile surface.

The northern division of the county is more diversified. The limestone of Mendip, and the hills thence to Bristol, are, however, a striking feature which, with that of the freestone in the eastern part before described, the blue marl, lias, and red ground, make up the general outlines of its strata. A large district of marsh-land, similar to that of the midland part before described, occurs on the shore of the Severn. The dry surface of the thick or mountain limestone, cannot be mistaken. The red marl occupies most of the intermediate spaces; and it is rather remarkable that this stratum is more noticed in this and the adjoining county of Devon than in many other counties where it occupies a much greater breadth of surface. This may arise from its being here frequently seen in higher situations.

The coal is now all worked at a great depth beneath this red marl; and it is very remarkable, that the coal districts of Somersetshire present not the least appearance of the general poverty of soil in coal countries.

10. GLOUCESTERSHIRE.

Gloucestershire is distinguished in the northern part by the stony district of the Cotswold hills, in the southern by the collieries of Kingswood, in the middle by the vales of Berkley, Stroudwater, and Gloucester, which, all together, seem to be comprehended in the one great vale of Severn, whose utmost limits of breadth are formed by the bold outline of the Cotswold hills on one side, and the ridge which

stretches from Malvern to the Forest of Dean on the other; but this ridge is divided, opposite Gloucester, with a fine valley of red land, which extends up to Herefordshire.

The woody, and part rocky, district in the angle of the Severn and Wye, which comprehends the Forest of Dean, seems like an insular part of this county. This forest has been long noted for its fine timber, and, by the help of works recently established, will shortly be equally famed for its coal. This is, in fact, one of the largest districts of that valuable mineral which has, till lately, remained in obscurity.

19. WORCESTERSHIRE.

Worcestershire is much like Warwickshire, chiefly composed of red marl and red sandstone, with interspersions of gravel, and a considerable breadth of lias and its clay, on or near the surface in its south-eastern part. The rich vale of Evesham, and its insular hills, make a pretty variety, which are also similar to the southern parts of Warwickshire. The base and sides of these are of blue marl, and their tops only of stone. A range of hills on its south-western side, with others near its northern boundary, and those before mentioned, seem to circumscribe the principal part of the county as one great vale, through which the rivers Avon and Severn flow to their junction at Tewkesbury.

The western and most northern parts partake of the irregularities of coal and limestone eminences, and retain, in the Forest of Wire, some of the original wildness of coal-measure surface, wet land, and soft and bad roads.

20. WARWICKSHIRE.

Warwickshire has but little variety of strata, and not much of surface, the greater part of the county being upon the red marl, and

its more sandy and loamy varieties, where the red sandstone lies within a few feet of the soil. A large portion of this kind of land, now very well timbered, was originally called the Woodlands, as the north-eastern part, somewhat more hilly, on the course of the lias limestone, was called Feldon. Still higher lands of the under-oolyte form its eastern and southern boundary. The sides and base of these hills, and all the low land thence to the lias, is of the blue marl which is common to the pastures of the adjacent counties. Its other eminences, which form the boundaries of drainage to the rivers Trent and Avon, are only of such moderate altitude as is common to the red marl and its stone. It has great advantages from coal, without the poverty of soil occasioned by a surface of coal-measures.

21. LEICESTERSHIRE.

Leicestershire is one of those midland counties which have a striking similitude to each other. It bears the greatest resemblance to Warwickshire and Worcestershire, from its being composed of much the same materials, red marl, lias, and blue marl, and interspersions of gravel nearly in the same proportion, with a moderately elevated eastern boundary of marly hills, which have some stone on their summits. These form the bold margin to the vale of Belvoir; which vale, with a surface of lias and its marly clays, form the principal features of that side of the county.

Charnwood Forest, with its irregular surface, and substrata of slate and gneiss, equally irregular, give bolder features to the north-western parts; and the westernmost extremity in Ashby wolds and the moors about Cole Orton, before they were cultivated, must have shown much of the poor natural characters of coal land.

22. NORTHAMPTONSHIRE.

Although the chief part of Northamptonshire is in the course of the great oolyte rocks which form the dry surface of the Cotswold

hills, the stone here becomes so thin, and the parts of it are so widely dispersed, as to give this county a much better soil and more agreeable appearance. The variations from this kind of land (which is frequently called stonebrash) to a strong clay, is all that the county admits of.

From Peterborough great fen, which is in this county, a moderately elevated ridge of strong blue clay forms its south-eastern boundary against Huntingdonshire. To this succeeds a stratum of limestone in the same direction from north-east to south-west, with a drier surface and much better soil. Many interspersions of clay occur, with rounded fragments of chalk, which proves this kind of surface alluvial; and in other places, the regular strata of forest marble or slatey stone are imbedded. These two sorts of tenacious and wet soils form much of the ancient forest land; some still remains in wood, and much was, till lately, in open fields or common.

The freestone rock, which, in some parts, produces fine stone for building, is the substratum of most of the dry arable land. It is more sandy and reddish about Northampton, and rises thence on the tops of the hills to the highest land on the extremity of the county. It is in these parts chiefly that the blue marl and clay occupy the valleys, and form the strong soil which is now generally appropriated to pasture. On the borders of Leicestershire, the land consists wholly of this kind of clay, with some interspersions of soft dirty gravel, which is a curious mixture of rounded fragments of different strata, principally from the eastward.

23. HUNTINGDONSHIRE.

Huntingdonshire has less variety of strata than any other county, nearly the whole of it being composed of one thick substratum of clay, varied only on the surface by casual interspersions of gravel. This alluvial matter is most abundant round Huntingdon and other places on the great north road: it is not, however, deep to the substratum of

strong blue clay which constitutes the general base of the county. This stratum of blue clay, from its great thickness, forms considerably elevated ground on the western side of the county. The north-eastern side embraces a considerable part of the fen; and, but for a small portion of a thin limestone rock at Elton, &c. in the northern extremity of the county, Huntingdonshire might be said to have no stone.

24. RUTLAND.

Rutland is the smallest county of England, and has but little variety of strata, its heights being composed of stone, and the valleys of clay or blue marl. Its eastern part, through which the great north road passes, has all that dryness of surface, with a hollow rock beneath, and rubble-stone soil, which characterize the course of the great oolyte rock, and which, from its being almost wholly in tillage, and inclosed with stone walls, and equally destitute of timber, makes it greatly resemble some parts of the Cotswold hills.

25. LINCOLNSHIRE.

This county is not altogether so fenny as is usually supposed, the adjacent parts of the low lands in Northamptonshire and other counties being frequently called by the general name of Lincolnshire Fens.

Lincolnshire is a large county, and partakes of the varieties of strata common to the south-eastern and midland counties. The fens, and two considerable parallel ridges, one of chalk and the other of stone-brash, are its principal features. It has, however, several other distinct varieties of soil and substrata. These may be taken in succession from east to west. The great district of rich feeding marshes and clays adjoining, with their marine sandy margin, is one; the open and airy ridge of chalk, another; the sandy heaths and rabbit-warrens, a third; the clay, or golt, of the interior emmet-hill pastures, a fourth; the stone ridge and light soil over it, a fifth; the low ridge of lias limestone

and its clay, in many places with a poor alluvial sand covering, a sixth; and the red, containing gypsum, between that and the Trent, a seventh. These occupy the county in long narrow strips; but in Kesteven, on the borders of Rutland, the oolyte expands into a considerable breadth of stony surface, resembling the Cotswold hills.

26. DEVON.

Devon and Cornwall, as the Danmonia of the ancients, seem still to have a kindred union; and some parts of these counties, from the nature of the strata and their mineral products, must be much alike. Yet the extraordinary protrusion of Cornwall into the sea, and the superior quality of Devonshire soil, render a still greater part of them essentially different.

Devonshire is generally considered a county abounding with rich soil: this may be true with regard to the red land and South Hams; but Dartmoor, Exmoor, and part of Blackdown and Haldon, make large deductions from this general good character of the county.

Dartmoor, at the height of eleven to eighteen hundred feet above the level of the sea, with immense blocks of granite on its heights, and broad surfaces of black peat in its valleys, is the most dreary waste that can well be conceived. Exmoor on killas, and Blackdown on silicious sand, are not much better. Many small moors are interspersed through the red substratum of the broad flat between the two mountains of Dartmoor and Exmoor. Much of the red sandy surface is carved into deep hollow-ways. Rounded fragments, or alluvial pebbles, are very common to this part of the county, and give its soil a great resemblance to the gravelly parts of Worcestershire and Nottinghamshire.

27. MONMOUTHSHIRE.

The prominent features of Monmouthshire are its insular mountains, and the beauties of its bordering river; the latter produced by

the bold terminations of limestone, and the other by strata of sandstone, dunstone, and reddish brown marl, which is remarkable for producing a surface abounding with insular hills, frequently in a conical form, but none which rise so majestically as the Sugar-loaf and adjacent mountains of Monmouthshire.

The more western part of the county has lately become extremely wealthy and populous from its valuable mountains of coal and iron. About a sixth part of the great coal-field which extends into Carmarthenshire, is in this county.

28. HEREFORDSHIRE.

Red marl, reddish sand, and red sandstone, are the prevailing strata of this county. The high land in the south, through which the Wye works its way, and that about Malvern, abounds with limestone, which is also very plentiful along the north-eastern and northern borders of the county.

The strata of red and dun-stone on the south-western side rise from hill to hill, between the branches of the Munnow, to the character of mountains, which have much the same altitude as those of the same strata in the adjacent counties of Monmouth and Brecon. The Wye, in its passage through these strata, being confined to a narrow valley, gives these heights a connected appearance with those which skirt the Welsh mountains on the Radnorshire side of the county.

A hilly margin of kindred strata in the north, continuing to Ludlow, forms, with the other sides, as before described, the principal part of the county into an immense central valley, watered and drained by the beautiful rivers Lug and Wye, from the midst of which there is no appearance of their entrance or escape. The richness of this vale around Hereford is well expressed in its name of Golden Valley.

29. SHROPSHIRE.

The south-eastern part of the county, to the side of the Severn, and part over that river, consists chiefly of the sandy friable soil which is the common surface of the red sand, sandstone, and red marl which stretches into the county from Staffordshire and Worcestershire. Much higher ground, containing coal and iron in abundance, succeeds to this, forming the woody and dirty surface of the forest of Wire and Clee hills, and from thence, in a north-easterly direction over the Severn, to the similar eminences above Colebrook-dale.

A rugged district, which consists of the strata of some of the lesser mountains of Wales, succeeds in the south-west, stretches thence northerly along the western boundary of the county to the banks of the Severn, and forms the margin of the fine vale of Shrewsbury, through which this river passes. A further extension of the coal-measures skirts the southern and north-western sides of this extensive vale, and forms the exterior boundary of the county against the Denbighshire mountains. The greater part of the interior vale, and the moderately rising ground and hills thence northward, comprising one third of the county, consist of the same kind of reddish soil, gravel, marl, and red sandstone, as is common to Cheshire.

30. STAFFORDSHIRE.

A large portion of Staffordshire is composed of red marl, and its sand and sand-stones, some part of the surface of which is gravelly. Alluvial matter of great thickness on the edge of Cannock Heath also covers the coal-measures which stretch through the most extensive works in the kingdom to the southern boundary of the county. The eastern and western sides of this great coal-field are of nearly the same kind of red strata, but somewhat more sandy than the interior, which, in various alternations of stone and marl, stretches up to the other coal-district in the northern extremity of the county. The usual poor sur-

face of the coal-measures is here more clearly defined than in the district before described in the lower part of the county, and connects with, and resembles, the dreary moors which are common to such land in the high part of Derbyshire. Staffordshire has also some of the limestone by which its neighbouring county is distinguished. As this rock and the coal-measures last described, form the highest hills in this part of the country, and a boundary ridge continues thence west and southwards, almost to connect with the high land of Cannock Chase, the interior of Staffordshire is thus formed into a basin, or fine rich vale of vast extent, through which the river Trent meanders.

31. CHESHIRE.

The surface of Cheshire is so completely occupied by red marl, red sandstone,, and sand and gravel, that it may be said to have little or no other varieties of strata. The gypsum which accompanies the red marl is rarely seen, and the salt rocks beneath are found only at great depths by sinking pits. There is scarcely any stone observable on the surface of the interior of Cheshire, but what has evidently been rounded by attrition in water; and hence the proof of its alluvial origin. There is, however, an inner range of sandstone hills, chiefly confined to Cheshire, which appear to circumscribe the great salt district. Delamere Forest and Alderly Edge are parts of this kind of sandstone.

Coal-measures come into the eastern and western parts of the county under very different superficial appearances. That on the eastern and north-eastern border has all the roughness common to these strata in high situations. Some parts of the surface greatly resemble the adjacent High Peak of Derby.

32. LANCASHIRE.

Lancashire has its flat and its hilly parts. The southern portion of the flat, divided from Cheshire by the Irwell, appears like part of the

same great basin which, like that, has an abrupt termination in high land to the eastward. Moderately elevated land separates this from the other flatter part of Lancashire, which extends along the coast with high land also to the east. Red marl, sandstone, and large mosses, marshes, and sand-hills, occupy all the low grounds, and coal-measures all the high, except in Furness, a district of itself, which partakes of all the wildness and grandeur of mountain scenery common to a substratum of schist. The limestone and its accompaniments in Low Furness and Kendal, exhibit a pleasing variety of beauty and fertility, interspersed with large inlets of the sea at high water, which makes it truly an interesting district, assuming, at ebb tide, a different aspect, from the great breadth of sands which are then exposed.

The coal-measures between Prescot, Chorley, Colne, and Ashton-under-Line, are the general surface, which, in the high parts, is marked by all the dreariness of the wet and uncultivated moors which are common to these strata. The heights of Bolland are much the same; but the many advantages arising from the numerous coal-works in the south and south-west, have entirely changed the face of the country.

33. DERBYSHIRE.

Derbyshire is remarkable for its hills: part of these are formed of limestone; and a still higher part of the Peak, of the overlaying grits and shales of the coal-measures. The great difference in these hills may be seen at a distance; the limestone hills being generally clothed with a short green turf, while those which contain grit-stone are covered with heath, fern, or furze, which give them a brown appearance.

The same sort of surface which forms the High Peak, continues by the east moor to within a few miles of Derby, the high ground of which constitutes the west, as the ridge of magnesian limestone forms the east side of the broad vale of Scarsdale.

Derbyshire partakes largely of the red marl, but its surface is in many places thickly covered with gravel. This, as in several other counties, forms the best land. It is about an eighth part of the county, and no where rises to very high ground. The magnesian limestone of the eastern side, the coal-lands of the interior, the high wet moors of the Peak, and the large district of dry-surfaced limestone, which abounds with mines, are the principal features of the Derbyshire strata.

34. NOTTINGHAMSHIRE.

Nottinghamshire is noted for red marl, chiefly in the districts called the North and South Clays. This, and its varieties of sand, gravelly sand, and red and whitish sandstones, constitute by far the greater part of the county. The latter forms a dry surface, very different from that of the Clays, which ranges, like the other, from north to south, through the large district of Sherwood forest, about the centre of the county. West of this, and somewhat higher, is a more regularly defined ridge of the magnesian limestone, of which Nottinghamshire has a considerable portion, and also of the strata beneath, which produce those valuable collieries on the borders of Derbyshire.

The surface of that part of Nottinghamshire which lies south-east of Trent, is entirely of red, and its interlaid thin strata of blue clay, with the exception of some gravelly places, and two or three long ridges of lias and its blue clay, which stretch out beyond the general extent of the wolds in the adjoining county.

35. YORKSHIRE.

Yorkshire is a county of immense extent, which, in its eastern part, comprises all the strata of the southern and eastern counties; its interior, those of the midland counties; its western, those of Durham, Northumberland, and the part of South Wales which contains the

coal. Though the hills of the east moors and wolds are high, their altitudes are comparatively low to those of the coal-measures in the west and north-western parts of the county.

Except the moors and wolds before mentioned, nearly all the rest of this vast county has one general declination towards the east, from the tops of Whernside and Ingleborough to the mouth of the Humber. On the shores of this great estuary, and of the river Trent, and others connected with the Humber, are large districts of alluvial and low marshy land, evidently formed by a sediment of the sea. The strip included between a district of this sort, and the easternmost part of the coast, called Holderness, is of the strata incumbent on chalk, and much the same kind of soil as the east part of Norfolk. The wolds, on chalk, are as dry, arid, and open as Salisbury Plain. The clay and limestone of the vale of Pickering form a much better soil than that which succeeds it to the north and north-west. These dreary and most extensive surfaces of brown, rusty-looking ling, upon a substratum of soft sandstone, are worse than any other district. The blue clay, or surface of alum shale, which succeeds it in the deep vales of the North York moors, and at the foot of them, is not good, and, in some parts of the vale of York, seems covered with alluvial sand, which has not improved the surface. A redder and much better soil runs through the middle of the county, parallel to the magnesian limestone, along the west side of the vale of York into Cleveland, and forms some of the best land in Yorkshire. The dry surface of the yellow or magnesian limestone is parallel to the red. Its course through the eastern half of the county is along the great north road, and in the northern parallel, and very near to it. West of this a vast surface of coal-measures, generally producing a poor soil, and more or less productive in coal, rises gradually to the tops of the highest hills. Eminences on its eastern side, with those of the wolds and Hambleton hills, seem to form the extreme limits of an immense vale, the central part of which is the vale of York. The coal-measures form the largest portion of any of the Yorkshire strata. Its northern and western parts in Craven and Richmond are beautifully interspersed with a rich surface on a substratum of lime-

stone. These are the two principal districts of this kind of land which so much relieve the general dreariness of surface, occasioned by the bleak high and wet moors of the coal-measures; but which vast surface is also further broken and relieved by various interspersions of the dry and rich soil of limestone, in Swaledale, Yoredale, and others.

36. DURHAM.

The subterraneous products of Durham and Northumberland are the same, and the greater part of the two counties much alike.

Durham has its great coal district chiefly on the Wear, as that of Northumberland is on the Tyne; and Durham has also, like Northumberland, a large mineral district in its western parts. The limestone under the coal, which produces these mines, does not, however, in this county, any where in the dales, occupy so great a surface as about Hexham, in the next. Its moory or boggy topped, and sometimes rocky, heights, in the mineral district, are much the same. Durham, however, differs materially from Northumberland in the great breadths of limestone, which its eastern part contains, and also in the strong clay-land which lies between that and the sea.

Durham, like Yorkshire in the features which its principal rivers occasion, is characterized in its western parts by the long and extensive vales of Teesdale, Weardale, and Tynedale: only half of the first and last are in this county. Derwent also is a smaller intermediate valley, not equally distinguished by limestone and minerals, but its vicinity is better supplied with coal. At the head of this valley, between Weardale and Teesdale, are very extensive barren heathy districts. In Weardale and Teesdale, interspersions of a dry and rich soil upon limestone produce a pleasing variety.

37. NORTHUMBERLAND.

This county is most eminently distinguished by its coal; and the strata which produce this invaluable mineral, more or less, are spread over the whole county, except in Hexhamshire and some other interspersions of limestone, thence northward, through the middle of the county, to Holy Island and the banks of the Tweed. Some limestone comes into the eastern corner from Durham.

A large portion of Northumberland, and particularly in the western and high parts, abounds with extensive commons and wastes, or did so till lately, which nothing but the extraction of the subterraneous wealth of the county could ever bring into cultivation.

38. CORNWALL.

Cornwall, considered of itself, has not much decided character from its strata; and those who call it an unstratified county, might doubt of its having any. Considered, however, with relation to other portions of the earth, Cornwall is only part of a great connected whole, which differs not essentially from other surfaces on the same strata. The granite must generally form poor land, and the schist but rarely forms good. The granite occupies most of the high ground, from whence the rivers descend through valleys in the schist: the rugged characters of both which are here very different from that which they generally give to the elevated ground.

No land in Cornwall is very high, although the frequent abruptness of ascent gives it the character of a hilly country. Its central eminences of granite, though rocky, arid, and open, have none of the dreariness of Dartmoor. The spaces, as well as the elevations, are less; and though the surface be naturally rocky, arid, and sterile, and rendered still more so by numerous excavations for its minerals, every smooth spot of ground is rendered valuable, by the great population which such works require.

Bogs and moory surfaces, as the natural accompaniment of silicious fragments and water, are common to the valleys; these, with the immense quantity of alluvial matter which produces the shoad tin, with the general workings of the mines, must have greatly altered the rough surfaces which granite and schist, in other places, exhibit.

39. WALES.

Considering the limestone district of Glamorgan and Pembroke, with the coal behind it, apart from the rest of Wales, and the coal and limestone of Flintshire and parts adjacent also, the rest of the principality partakes of one common character. It is more or less elevated, and composed of those strata of which the most mountainous parts of this island are generally formed. Some of the red marl, and the soft sandstone which accompanies it, seems to approach the eastern border both of North and of South Wales; but, in either case, occupies only a small part, in Denbighshire and the vale of Glamorgan. The more general appearance of red along the eastern border, against Herefordshire and Shropshire, thence extending north and north-westward to its termination in the sea at Rhyddlan, in the vale of Clwyd, and expanding south-west through Breconshire to Carmarthen Bay, and so westward to Saint Bride's Bay, is part red sandstone, other stone, and red marl interspersed, which generally lies between the coal-fields and the slate. This forms a series of round-topped hills, or sugar-loaf mountains, which give a pleasing variety of surface to many parts of its extensive course; and, though very uneven, its soil is generally dry and fit for tillage.

A rougher surface succeeds, which is frequently interspersed with hard naked rocks, or large detached blocks of stone.

The rocks of this range of strata, between the red and killas, alternate with courses of hard blue and soft black beds of slate, and other stone, and with strata of imperfect limestone. As these hard strata

form the breastwork of the mountains, so the killas and other rocks, approaching to basalt, seem to complete their most lofty summits.

40. WESTMORLAND.

Westmorland has but a small portion of the slate and other rugged strata of the Copeland mountains. Its westernmost part is, however, entirely composed of these kind of rocks. Its north-eastern border, neatly as high, consists of strata of a very different description, in which there are some thin beds of coal. This valuable mineral, and its accompaniments also, occupy the heights of its south-eastern border; and a red brown sandstone follows the vale from Brough to the northern boundary of the county: but Westmorland is most remarkable for its limestone, which comes into the county in great breadths, both from the north and south, and dilates through the interior to its eastern border, in the vale of Stainmoor.

41. CUMBERLAND.

Cumberland has the extremes of high and low land: on its northern coast, a considerable breadth of low land, formed by a sediment of the sea; and, in its interior district of Copeland, mountains which rise to the clouds. These, formed of schist and its accompaniments, are remarkable for their rugged surface and beautiful lakes of clear water, pent up in cavities of the rock. The intermediate eminences are composed of limestone, coal-measures, and red, which gradually sink to the low ground in the vale of Eden. The north-western part of Cumberland is said to have a great resemblance to the opposite coast of Scotland.

42. SCOTLAND.

Scotland has some strongly marked features in the divisions of strata, which cannot well be mistaken. In the part which comes within the map, the confines of the Grampian Hills, and other still higher

ground, composed chiefly of schist and its accompaniments, are defined by a bold outline and remarkable passes into the mountains. The next district, of better land and inferior altitudes, on the red and dun-stone, is also well defined by the termination of the coal-measures, which occupy the lower lands, from the great Firth of Forth to the similar bay of the Clyde, with a few interspersions of limestone; which, with similar surfaces of red and dun-stone, in the eastern and southern parts, and high interior ridges of schist, completes the general outlines of strata in this portion of Scotland.

From this short account of each county it appears, that Dorsetshire, Wiltshire, Berkshire, Oxfordshire, Buckinghamshire, and Bedfordshire, are composed of similar strata, though differing considerably in the proportions of each.

CHARACTERISTIC DISTINCTIONS OF SOIL AND SURFACE IN THE COURSES OF THE RESPECTIVE STRATA,

DESCRIBED IN THE ORDER IN WHICH THEIR EDGES SUCCESSIVELY TERMINATE.

LONDON CLAY.

The strata which overlay the chalk, in the deepest part of the Thames depression, are of great thickness. They vary much in superficial appearance, from the strongest clays of Essex to the lightest sands of Norfolk. The clay is generally the highest, and the sand nearest the chalk, with an intermediate surface of loam or brick-earth, near the clay.

The surface of the ground formed by the dark blue or London clay, rises more generally into hills than that of any other division of the strata over chalk. Insular hills, moist pastures, strong arable lands, and woods, are the chief characters of the district within a circle of ten miles around London.

It seems to extend north-eastward, through the hills in Essex to the cliffs against the sea at Walton and Harwich. The cliffs of Shoebury and Sheppy, on each side the estuary of the Thames, and Hordel cliff, on the coast of Hampshire, appear to be the same.

CLAY AND BRICK-EARTH, WITH SOME SAND AND GRAVEL.

Much of the clay which extends over the higher parts of Norfolk and Suffolk, is clearly alluvial, it being very generally mixed with rounded fragments of chalk and other strata, similarly water-worn. Sand and gravel are intermixed but sparingly; and the circumstance of

these lighter soils being so generally on the sides of hills and valleys, which lie between the clay eminences and the chalk, leaves no doubt of its being the outcrop of an intermediate stratum. The clay is distinguished, in Suffolk, by the general name of woodlands; in Essex also, by woods and forests; and, in Norfolk, usually by greens. In other parts of these extensive strata, less obscured by alluvial gravel, considerable surfaces of reddish brown, and some lighter and darker coloured clays, with intermixtures of sand and small round pebbles, seem to be the general character of the best planes of strata over the sand. These are the timber soils chiefly productive of oak in the New Forest and parts adjacent, Berkshire, Hertfordshire, Essex, Suffolk, and Norfolk. Some of the same kind of loamy clay as forms the north-east coast of Norfolk, stretches along the north-east side of the chalk in Lincolnshire, and along the coast of Holderness.

SAND AND LIGHT LOAM.

Sand and light loam, mixed with small chert pebbles, is most commonly the surface between the stronger lands and chalk.

Heaths may be said to characterize the surface of some of the greatest breadths of these sandy strata, and are the principal feature of the stratum meant to be distinguished by this colour. This character is so striking to those who have seen either Wareham and Pool heaths, Bagshot heath, or Moushold, Cawston, and other heaths about Norwich, that it cannot be mistaken. These, with Swaffham and Brandon heaths, and those called Walks, on the sands of East Suffolk, are the greatest breadths of poverty and wretchedness, which this stratum gives to the country which it occupies; but numerous heaths, of less extent, in other parts of its course, which are not of much better quality, may be observed. Much of this land is now, and, until lately, much more of it was, appropriated to rabbit-warrens.

CHALK.

It is this thick stratum which forms the most considerable ranges of hills in all the eastern and southern parts of England. Its well-defined boundary makes an extensive chain of hills, stretching, like the courses of other strata, principally from south-west to north-east; but, through the Lincolnshire and Yorkshire Wolds, more in a northerly direction. The course of this stratum is marked by these and other dry plains, of the greatest extent, which have nothing like them in any other part of the island; and hence it will be readily perceived, that the ridges of down-land, spreading, in an easterly direction, through Surry, Kent, and Sussex, are branches of the same stratum.

A narrow branch ridge of this stratum extends from the downs in Dorsetshire, easterly, through the Isle of Purbeck, which seems to recommence in the Isle of Wight, at the point called the Needles, and thence takes an easterly course, through the high downs of that island, to its eastern shore.

Portsdown is a singular ridge of chalk, rising through the strata which generally overlay it.

The chalk, on many of the parts called Downs, lies so near the surface as to render the thin soil unfit for cultivation. These extensive plains, in the western and northern parts of the course before described, are of the same kind of short turf and dry surface as the South Downs, Epsom, Banstead, and Barham Downs. At the foot of the chalk hills, the soil turned up by the plough is white. The whole course of this stratum is destitute of timber.

GREEN SAND, PARALLEL TO THE CHALK.

In the western parts, where the sand immediately beneath the chalk is generally called green sand, its site is remarkable for a fine dry, mellow, deep, loamy soil, which is some of the best arable land in the

island, and remarkable for the growth of wheat; much of which, from different parts of its course, is sold for seed.

BLUE MARL, OR OAK-TREE SOIL.

The oak-tree clay is distinguished by the tenacity of its soil, and some of the finest oaks in the kingdom, in parks and woods along various parts of its course, which is generally very near to the foot of the chalk hills. Some of its greatest breadths are in the vale of Aylesbury, and in the vale of White Horse.

PURBECK STONE, KENTISH RAG, AND LIMESTONE OF THE VALE OF PICKERING.

This stone appears at so many widely-detached places, and often so differently circumstanced, as to render its course difficult to be traced. The three districts mentioned above, are the most striking and best defined parts. Its course may also be traced along the north side of the vale of Aylesbury, and thence across the Thames, between the clay and the sand.

IRON SAND, OR CARSTONE.

Great breadths of heathy surface, sandy roads, and deep hollow-ways, are the general characters of this stratum. The rusty-looking sandstone used in building, is also too singular to be passed without notice, especially where the mortar, in the coarse joints of its masonry, is spotted with small chippings of the stone, which makes it look like the heads of large rusty nails in strips of white paper. Specimens of this sort of masonry may be seen in West Norfolk and at Ryegate. As this stone is seldom carried far, the use of it is sufficient to mark the locality of the sandy stratum which produces it.

The course of this stratum, like that of many others, is much obscured by modern enclosures, culture, and planting. The extensive plantations of fir, at Longleat, Bowood, and Woburn, are instances of what were, only a few years since, the most dreary heaths, like several of those still remaining on the course of the carstone sand. They are the same in Kent and Sussex as in Bedfordshire, West Norfolk, and Lincolnshire. Rabbit-warrens are numerous along the sandy course of this stratum, which extends over an unusual space on North York moors, Sussex forest-ridge, and Blackdown.

CLUNCH CLAY, AND DARK BLUE SHALE.

The surface of this stratum is remarkable for circumstances which the most unobserving cannot pass without notice. Soft, tough, wet clay, in a state of nature, must ever have been the worst of roads, and most of the bye-lanes and parish-roads are so now. To remedy this inconvenience it may be noticed, that many ancient caused or raised ways have been made across the course of this stratum; which was generally done with pitching, or the flat and thin beds of the forest marble, or sandstone rock, set on edge. Every traveller must unavoidably observe this character of the stratum under consideration. It will be known to the agriculturist by its wet, tenacious properties and difficulties in tillage. The grazier and skilful land-surveyor well know its pastures by the blue cast of carnation-grass, and other coarse herbage; and its emmet-hills and blackthorns are sufficiently characteristic for the general observer. These are the features which may be readily traced through every part of the country which produces it; but its course may be found on a map, by certain districts of low lands, which are frequently subject to inundation. It forms the chief boundary of the great level of the fens, and continues thence northwards, through wet and low lands, to the estuary of the Humber.

All the low land of the vale of Bedford, Ottmoor, North Wilts, the vale of Blackmoor, and the watery vale of the Isis, from

Cricklade to Oxford, is upon this stratum. Its course is also more particularly designated by many smaller names of moors, forests, commons, and waste lands, or at least by such as have till lately remained in that state.

CORNBRASH LIMESTONE.

The cornbrash is very aptly described by its name, as, in the western part of its course, parallel to the strong clay lands before described, this is almost the only land in tillage. In Wiltshire it is called cornbrash, and in Northamptonshire redbacks. It makes, generally, a good soil. Its course is marked by several considerable market, and other larger towns, which are mostly situate at the places where the outcrop of this stratum crosses the rivers. It never rises to high ground, but forms the easternmost of all the wide stony district, which ranges through the interior, and, being the hardest and best of that stone, is, in many parts of its course, and in that of the clays adjoining, much used on the roads.

FOREST MARBLE.

The locality of the forest marble may be known in many parts of the narrow district which it occupies by the common use, in the villages, of the coarse large flag-stones and rough slate which it produces. The cottage gardens are fenced with these flags, set on edge, in many of the villages near the quarries. The stone is imbedded in clay; the pits frequently hold water. The soil over this stratum is not of the best quality, being of the kind called woodland soil, frequently wet and difficult to cultivate; hence much of it is in wood, or has lately been so. Its course is marked by the forest of Wichwood, and the forests in Northamptonshire. It frequently rises to higher land than the cornbrash, and sometimes clings so close to the great oolyte as to form part of the same hill, and in some cases is not easily distinguished from it.

GREAT OOLYTE, OR FREESTONE.

The vast districts of downs and open fields, recently converted into dry arable lands, inclosed with stone walls, sufficiently characterize those strata which, on the Cotswold hills, must be well known to the numerous visitors of Bath and Cheltenham. In some parts of Oxfordshire, these walls, and similar appearances, are common; but in Northamptonshire, and other districts of these strata, where clayey interspersions more frequently occupy the surface, hedges have been more generally planted; but the stone walls, and a similar openness of country and aridity of soil, re-appear in Rutland and in a part of Dorsetshire north and north-east of Sherborn.

Roads mended with freestone, or soft limestone, which readily grinds to a soft whitish paste, dusty in summer, dirty in winter, and generally in a bad state, seem characteristic of the course of these extensive strata.

The peculiar dryness of the soil, and vast extent of country without water, will enable the traveller readily to distinguish the site of this stratum.

UNDER OOLYTE.

This stratum is frequently so blended with the one above, in the slopes of the same hill in all the southern parts of its course, as not to be distinguished from it but in maps of a larger scale. It makes a redder, and, generally, a better soil, than that of the upper oolyte, and in Oxfordshire, Northamptonshire, and Rutland, is widely detached from the other rock, lying only on the tops of the hills, and about Northampton and other parts becomes very brown and sandy.

In Rutland the surface of the oolyte rocks has much the appearance of the Cotswold hills, and their northern course through Lincoln-

shire forms a very long and narrow straight ridge, which has a singular opening in it at Lincoln.

BLUE MARL.

Much of the stiff soil of this stratum is now in pasture, though it appears, by the high ridges in the midland and northern parts of its course, to have been formerly mostly in tillage. This stratum expands over a great space in the southern part of Somersetshire, where, as in the vale of Gloucester, it produces many of the best orchards, and some excellent grazing grounds. It spreads wide on each side the vale of Evesham, through the vale of Red Horse, produces the same kind of pasture in its course through Warwickshire and Leicestershire, and the vale of Belvoir to Lincolnshire, and, in a large portion of Northamptonshire and Oxfordshire, becomes much interspersed with the stony lands of the stratum above. From a general want of stone, the roads in the course of this stratum are bad, except where foreign materials have been introduced by canals or other water-carriage.

BLUE AND WHITE LIAS LIMESTONES.

The blue lias limestone, composed of thin beds of stone, imbedded in clay of the same colour, lies at the edge of the blue marl district, and makes a surface so little differing from that of the blue marl as to be frequently passed without notice. The white lias beneath it is still less seen except in particular parts of Somersetshire, where its planes happen to be parallel to the surface of arable land, and fragments of its flat beds turned up with the plough. These rocks are better exposed in the quarries of Somersetshire than in any other parts of their course.

RED MARL.

The red marl, red earth, and its beds of soft red sandstone, and in some places whitish blue beds of indurated clay, or stone, are first noticed on

the south coast of Devon, and in that county and in the vale of Taunton, adjoining, form exceedingly good land, which is thickly covered with fruit-trees. It is much interspersed between the hills in the northern parts of Somerset, and there, and in part of Gloucestershire, adjacent, frequently sunk through for coal. Its surface is narrowed over the Severn by the sudden rising of the coal-measures in the forest of Dean. It extends thence northward by the Severn to Worcester, where an immense expansion of it commences, which extends northward over the greater part of four or five counties. At Nottingham another contraction is occasioned by the lias and coal-measures, and its great breadth thence northward, through the north and south clays, is again contracted by the fens; and the alluvial of this low land continuing thence up the vale of York, still further reduces the breadth of this remarkable stratum, which may, however, be distinctly traced to the borders of the sea in the county of Durham. A great breadth of it passes over the summit of drainage between Staffordshire and Shropshire, and expands over part of the latter county, nearly over the whole of Cheshire, and a large portion of the flat district of Lancashire. In some parts of its course it seems to contain other considerable strata of limestone. Limestone breccia, gypsum, sulphat of strontian, rock-salt, and various sandstones, are found in it. From such great variety, extent, and thickness, it assumes very different appearances, and its surface is in many places much obscured by alluvial matter.

MAGNESIAN LIMESTONE.

The magnesian, or yellow limestone, which may be very distinctly traced from the neighbourhood of Nottingham, northward to the sea-side, at the mouth of the Tyne, is, in some parts of its course, marked with the characters of poverty and rough herbage, unusual to limestone.

The magnesian limestone, like that of Mendip, seems to lie in, and belong to, the great stratum of red earth which forms the eastern boundary of coal. It is, in several parts of the north, perforated for that mineral.

COAL-MEASURES.

The mass of strata usually called coal-measures, is known to be deprived of much of the superficial space which it would occupy by the overlapping of the red earth. When this unconformability of the red earth shall be more generally known, and its irregular thicknesses more correctly proved, it is highly probable that much more coal may be discovered, and the coal-measures be found as regularly connected as other strata. This opinion is confirmed by the great obscurity of coal-measure outcrops, in many of the districts where coals are now working; and it may be further remarked, in confirmation of this opinion, that those coal districts which are near to or surrounded by red, show less of the superficial character common to those strata, than any other parts of their extensive course. The Warwickshire, Leicestershire, Staffordshire, and low part of the Lancashire and Cheshire works may be enumerated.

In the higher situations to which these strata ascend, in South Wales, the Forest of Dean, Shropshire, Derbyshire, and thence northward to Berwick on Tweed, the surface of the coal-measures is much alike, and such as cannot be mistaken.

Particular parts of this series of strata give particular features to the places they occupy, which cannot be noticed in this concise description, which is intended only to explain the different parts of the map. These strata, like the red earth before described, seem to bend over the summit of drainage into Lancashire and other districts.

DERBYSHIRE LIMESTONE.

The limestone of the Peak of Derby, which rises from beneath the coal-measures, is a part of the same kind of rock which appears at intermediate distances under the same circumstances, thence up to its termination in the sea, north of Berwick on Tweed.

Craven, Richmond, and Hexham, are most conspicuous surfaces on this rock. In a part of Westmorland and Cumberland also, it seems to underlay the coal. It reappears, under the same circumstances, in Flintshire, and may be thence traced to the corresponding point in the sea, in South Wales. The greatest mineral districts are in the course of this limestone.

RED AND DUN STONE.

The course of the red rhab, as it is called in South Wales, and of the red and dun stone of Monmouthshire, may be distinguished by its colour and a peculiar unevenness of surface, abounding with deep narrow dingles, through which small streams of water descend with rapidity. Some parts of its surface soil have a good herbage; the portions in cultivation produce corn of a fine quality; and others, too steep and too high for the plough, are good sheep pastures.

So many alternations of red and grey sandstone rocks, with indifferent limestone, and much reddish indurated marl, may be expected to produce a great variety of soil. Conical hills, like some in Scotland and Wales, and the Sugar-loaf in Monmouthshire, are its most striking characters.

VARIOUS—LIMESTONE AND SLATE.

Very hard grey stone, with blue flinty slate, in almost vertical courses, a blackish soft stone, which resembles some of the accompaniments of coal, with beds of imperfect limestone, occupy the space between the red and killas, and may be expected to produce a soil as various as the substrata; and, from the same cause, many parts of the surface also rise into the most singular and romantic hills.

KILLAS AND SLATE.

The soil, on shattery fragments of these strata, is good, where tinged with red, and the stone is loose enough to be absorbent, as in

some parts of Somerset and Devon. Oaks grow kindly on the steep sides of the woody glens in these strata. And in some parts of Wales, where these rocks are water-tight, such yellow tough clay may be seen as generally produces oak. The strata of slate, in the most mountainous parts, usually occupy lower situations than the harder rocks, with which they alternate: some of these, on Snowden, approach the regular figure of basalt. The deep narrow valleys of these mountainous districts are filled with fragments of the more rocky heights, abound with large lakes, or are very wet and springy: hence those who have seen the sharp-pointed mountains which pierce the clouds, and the deep bottoms of spungy peat, which hold the water they produce, may account for the humidity of these high situations.

GRANITE, SIENITE, AND GNEISS.

The surface of a granite country, and its great irregularly rounded outlines, bespeak the massive nature of its substrata. Nothing can be more gloomy than the frowning brow of Dartmoor, which overhangs Oakhampton; or more dreary than the rusty-looking surface of the higher parts of the moor, interspersed with deep boggy valleys, and tors or huge masses of rock, against the horizon, instead of trees. Lower situations are drier and better; but large lumps of the sterile rock will peep through the barren soil, which seems to be composed of little else than the pulverized fragments of the rock itself. The most remarkable surfaces on these strata, at Malvern, Mountsorrel, and in Anglesea, Cumberland, and the south of Scotland, are small compared to those in Devon and Cornwall; and, but for the singular nature of the rocks, make but little figure in the general features of the country.

THE END.

S. Gosnell, Printer, Little Queen Street, London.

ERRATUM.

Page 21, under BEDFORDSHIRE, line 2, *for* an *interior*, read, an *exterior* ridge of chalk.